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Jigsaw as a curriculum strategy to enhance pre-service teachers' understanding of economics calculations

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Background: Economics is a discipline that ought to explain the world and its complexities, a social science that studies human behaviour and decision-making. Both learners and aspiring pre-service teachers (PST) who want to teach economics education view economics as complex. Pre-service teachers lack the necessary mathematical skills and feel intimidated by the quantitative nature of economics. As a result, they struggle to understand and apply economic concepts and to teach effectively. Hence, there is a need to learn new actionable approaches and strategies in teaching and learning in the economics classroom.

Aim: The study aims to explore the use of Jigsaw puzzle games as a curriculum strategy (CS) to augment PSTs' understanding of teaching calculations in the economics classroom.

Setting: The study looks at economics calculations through the lens of architecture theory. the study takes place on campus in the economics lecturer room where pre-service teachers attend economics classes.

Methods: The study explored the discussions including the observations of six PSTs using a qualitative approach. Critical discourse analysis was used to analyse data.

Results: Findings revealed that participants found the Jigsaw extremely insightful and interesting. They were further amazed by its ability to ignite critical and deep thinking to arrive at the right solution.

Conclusion: The study concludes that introducing Jigsaw as a CS for PSTs can significantly improve their ability to teach calculations and concepts in economics effectively and actively.

Contribution: The study has implications on how PSTs can engage in gamification while learning and demystifying the power of complexity in economic calculations.

Keywords: Jigsaw puzzles; pre-service teachers; economics education; architecture theory; economics; management sciences; curriculum statement; curriculum practice; economics calculations.

Introduction

Economics is one of the three subjects that form Economic and Management Sciences (EMS) in the senior phase (SP) Grades 7–9 (Jonda & Modise 2022). Taking Economics as a major in Further Education and Training Phase (FET) Grades 10–12 will provide learners with real-life skills that will help them develop personally, socially and economically. Generally, the study of economics focuses on how individuals, businesses and governments within our society decide how to use scarce resources to satisfy their extensive needs and wants in a manner that is efficient, cost-effective and sustainable. Diagnostic report for Grade 12 assessments indicates that learners are struggling with the economics calculations (EC) presumably dealing with the Keynesian multiplier calculations and graphical depiction as abstract concepts (Department of Basic Education 2021). Moreover, economics is deemed not only complex to learners but also to pre-service teachers (PST) who aspire to teach economics education (EE). Kazempour and Sadler (2015) attest that some PST lacks the necessary mathematical skills and feel intimidated by the quantitative nature of economics. As a result, they struggle to understand and apply economic concepts and to teach effectively. Hence, there is a need to learn new actionable approaches and strategies in teaching and learning in the economics classroom.

Jacobs (1989) describes curriculum strategy (CS) as a plan or approach to designing and implementing a curriculum that reflects the educational goals and objectives. It involves making decisions about what to teach and how to teach it. A CS may include designing courses, selecting

instructional materials, identifying assessments and establishing instructional approaches to enhance learning outcomes. Kam-wing (2004) describes Jigsaw as an instructional curriculum approach that involves breaking down a large topic into smaller pieces, assigning each piece to different groups of learners and having them teach that piece to the rest of the class. In fact, Van Wyk (2015) postulates that Jigsaw has been used in many contexts and is an effective way of promoting collaboration, active learning and critical thinking. Furthermore, Jigsaw puzzle games can be used as a practice in the EE curriculum to improve understanding of the EC in the economics classroom essentially simplifying the calculations and depiction of graphs (Van Wyk 2017). The Jigsaw method is a cooperative learning methodology in which each member of an activity group focuses on one aspect of a topic. The learners then come together in 'expert' groups to discuss their aspect of the topic and share their knowledge with their home group (Mshayisa 2020). This method encourages active participation and problem-solving abilities in learners.

The use of puzzles in teaching and learning has been shown to improve understanding of abstract concepts and develop problem-solving abilities in learners. Using puzzles to reinforce language arts, mathematics, science and social studies skills can be beneficial for children and hone their problem-solving skills (Saldanha 2019). Jigsaw puzzle games can also help boost confidence in PST by providing them with a feeling of accomplishment when they solve a problem (Mshayisa 2020). Puzzles allow PST to explore many different approaches to solving problems and to think creatively to find the best solution. By engaging in this type of activity, PST can test their knowledge and discover if they are capable of understanding more complex concepts. Furthermore, puzzles can also foster collaboration among PST, encouraging them to work together to solve a problem (Alam 2022).

Despite the many successes recorded in the use of Jigsaw puzzles, Matthee and Turpin (2019) argue that puzzles can be too challenging for some to learn, leading to frustration and a feeling of being overwhelmed. PST may also become bored with puzzles if they are frequently used. Additionally, Kade, Degeng and Ali (2019) argue that puzzles may not be the most effective way to teach certain abstract concepts, as some PST may need more direct instruction. Nonetheless, the study supports the argument that Jigsaw creates a joyful environment, while this simplified CS enables PST to deal with abstract calculations and improves the participation of PST in ECs.

For this reason, the study intends to explore the use of Jigsaw puzzle games as a CS to augment PSTs' understanding of teaching ECs in the economics classroom. This study was carried out qualitatively, through discussions and observations. Pre-service teachers who have completed 2 years of Economics courses as part of their teacher preparation programme and are in their final year will be included in the study. This study employed data analytic tools to determine the impact that Jigsaw puzzles can have on the learning process. Furthermore, the research will look into how PST might improve their understanding of teaching ECs in their future classrooms.

Problem statement

The study of economics should provide insight into the world and its complex dynamics (Collins et al. 2019). Economics may also help society to understand the connections between markets and how different countries interact. Furthermore, Makapela and Tanga (2022) view economics as a key instrument that gives citizens a greater appreciation for the global economy and its implications on their lives. By understanding economics, we can better identify trends, assess risks and make educated predictions about the future trajectory of the economy.

National Senior Certificate Diagnostic Report 2020 part 1 (Department of Basic Education [DBE] 2021) outlines an analysis of the national performance of Grade 12 learners in economics. The report discloses that, out of the 118 484 Grade 12 learners who participated in the economics final examination, a total of 68% attained scores ranging from 30% to 40% on their final grades. Consequently, students with lower grades may have limited options for the choice of courses or majors they can pursue at the tertiary level. Accordingly, Bassett (2021) maintains that students with weaker foundations in economics may struggle in their early tertiary courses that require calculations. They may find it challenging to keep up with coursework and may need additional academic support. Furthermore, the report indicates that high-order questions that are calculation intensive remained a challenge for Grade 12 learners to answer correctly. The report suggests that learners should be empowered by teachers as early as in the lower grades to improve their ability to tackle high-order questions in Grade 12. The extract from the report below speaks:

> When teachers fall behind in content coverage, topics under Economic Pursuits and/or Contemporary Economic Issues tend not to be taught thoroughly. Candidates who attempt questions on such topics perform poorly in comparison to other topics. Teachers should structure assignments, projects, and case studies in Grades 10 and 11 on the challenging topics of Grade 12, e.g. competition and collusion, economic and social indicators, to promote the acquisition of some basic knowledge when these topics are discussed in Grade 12. This is also an area in which teachers must be supported by subject advisors. (DBE 2021:83)

Both economic pursuits and contemporary economic issues weigh 50% of the curriculum in the FET phase Grades 10–12 based on Curriculum and Assessment Policy Statement (CAPS) document (DBE 2011). Another reason why these topics may not be thoroughly taught is because of the presumed complexity of the calculations even for teachers. The challenge of calculations for both learners and teachers has been deemed a challenge over some time. For instance, Kirzner (1988) observed a debate on understanding ECs over

three decades. In addition, Tican and Deniz (2019) write about the PSTs' opinions on the use of 21st-century learner and 21st-century teacher skills. At the centre of their argument is the issue that deals with numeric skills as a necessity in the 21st century.

Despite these challenges, economics can still provide valuable insight into the world and its complexities. By analysing economic data and trends, economists can identify patterns and relationships between different variables that can inform decision-making and policy development (Collins et al. 2019). This can help individuals, businesses and governments make informed choices that reflect their goals and priorities. Teacher educators should assist pre-service EMS teachers to understand the complex relationships between ECs and how to show and interpret these calculations in the form of a graph. In addition, they need to guide them in developing critical thinking and numeracy skills that may translate into improvement in their future economics classroom.

A strategic aim in empowering pre-service EMS teachers with the ability to simplify ECs is to explore Jigsaw as a CS to augment PSTs' understanding of teaching ECs in their future economics classrooms.

Literature review

There is a growing body of literature discussing the effectiveness of the Jigsaw CS in augmenting students' understanding of subject matter across a range of academic disciplines. To illustrate this, Button et al. (2021) discovered that using a Jigsaw as a CS can decode and simplify controversial and contemporary economics topics. Van Wyk (2015) further argues that the use of Jigsaw as a strategy may advance the acquisition of knowledge for economics teachers. Bidemi (2022) conducted a study in Nigeria and claims that teaching ECs in the economics classroom, using a Jigsaw as a curriculum practice strategy has the potential to increase PSTs' understanding of the calculations. A systematic review of the literature conducted by Button et al (2021) identified several studies that successfully utilised the Jigsaw strategy in teaching various topics in economics. These studies revealed that Jigsaw improved students' academic performance, promoted interaction among students and improved attitudes towards learning economics.

The Jigsaw teaching strategy is a cooperative learning approach that allows learners to specialise in one aspect of a topic. This strategy has been used in various subjects and grade levels, including economics (Aronson 2021). A study that utilised an action research approach found that the Jigsaw strategy improved learners' learning performance and promoted positive interdependence among learners (Jainal & Shahrill 2021). Another study explored the impact of Jigsaw pedagogy as a cooperative learning approach to teachers' learning during an EE training project and found that teachers expressed positive attitudes towards Jigsaw learning and enjoyed the group spirit (Alrassi & Mortensen 2020).

The Jigsaw strategy has been evaluated in various studies in the United States, including Moskowitz, Burns and Williams (1985), who found that the Jigsaw technique was effective in promoting positive interdependence and individual accountability. Aronson and Patnoe (1997) also found that the Jigsaw technique improved learners' attitudes towards school and their classmates. The Jigsaw technique has been used in various settings, including classrooms, teacher training and professional development. Despite the positive findings of Moskowitz et al. (1985) and Aronson and Patnoe (1997), the Jigsaw strategy has not been extensively studied and its effectiveness in various settings has yet to be fully determined. For example, there is also a lack of evidence to suggest that the Jigsaw technique is effective in promoting long-term positive outcomes (Alrassi & Mortensen 2020).

Lastly, the Jigsaw strategy has been widely praised for its effectiveness in promoting collaboration and meaningful learning. Its popularity is also because of its simplicity and low cost, making it an attractive option for use as a CS in educational institutions. In addition, the Jigsaw technique provides PSTs with opportunities to interact with their peers, developing important social skills in the process.

Theoretical framework

The study looks at ECs through the lens of architecture theory. Architecture theory as a paradigm is a way of looking at the world that emphasises the importance of understanding the structure and design of the physical environment (Luck 2019). This approach has become increasingly relevant to EE, as it provides a framework for understanding the economic systems that shape our lives. Architecture theory has been a major influence in educational research, particularly in the transformative paradigm. This paradigm is based on the idea that education should be a transformative experience, one that encourages students to think critically and to develop their unique perspectives. Architecture theory has been used to explore how physical spaces can be designed to facilitate learning and foster creativity and collaboration. It has also been used to examine how the built environment can shape the educational experience, both in terms of the physical environment and the social and cultural context.

Architecture theory has been used to explore how the design of physical spaces can influence the learning process. For example, research has shown that classrooms that are designed to be open and flexible can encourage student engagement and collaboration (Imms & Byers 2017). Additionally, Kariippanon et al. (2019) demonstrated that classrooms that are designed to be aesthetically pleasing can create a more positive learning environment. Calculating the cost of a project design and structure calculations are a core concept in architecture that links the same narrative applied to calculations in economic education. Architecture theory can be relevant to EE calculations in several ways. To start with, architecture theory can help pre-service EMS teachers understand how different economic systems interact with each other. Architecture theory, therefore, forms the basis for

a redesigned classroom where Jigsaw as a CS may be implemented to augment the knowledge of PSTs and enable them to excel in ECs.

Research methods and design

The study preferred qualitative research design as an approach to the process of data collection for this study. Qualitative research designs are often used in EE studies to explore the experiences, perceptions and opinions of students, teachers and other stakeholders in the EE system (Gabrielian 1999). Oke and Fernandes (2020) also used a qualitative research approach to explore the perception of pre-service economic and management sciences teachers (PST EMS). Qualitative research designs can be used to gain a deeper understanding of the dynamics of EE, including how students learn, how teachers teach and how the EE system is structured. Qualitative research designs can also be used to explore the impact of economic policies on education, the effectiveness of different teaching methods, and the effectiveness of different economics curriculum. Qualitative research designs can be used to identify areas of improvement in EE and to develop strategies for improving the EE system.

Study population and sampling

The targeted population for this study was the PSTs enrolled in a teacher education programme in one of the 26 universities in South Africa from the first year to the third year. The preference was the PST EMS specialising in EE as a subject, especially in their third year of study. Third-year PST EMS would have been exposed to ECs for six semesters, two each year until their third year.

Six PST EMS recruited for this study through purposive sampling, four females and two males. Kothari (2004) writes the researcher using purposive sampling identifies and selects participants who have relevant knowledge or experience related to the research question or topic of interest. This sampling procedure is often used when the research population is small, hard to reach or when the researcher wants to study a particular group or subgroup of the population. Following Kothari`s guidance, the participants were selected because of their performance and understanding of complex ECs and graphs based on the time they had spent engaging in ECs (six semesters). Participants have constantly been achieving above average in economic education specifically on the calculations and graphs that are in essence deemed complex.

Data collection tools

The study used free attitude discussion and observation data collection tools. Free attitude discussion is a data collection tool used in qualitative research to gather in-depth information about an individual's attitudes, beliefs, opinions and perspectives on a particular topic or research question. It involves the researcher conducting an informal discussion with participants to explore their views and experiences related to the topic of interest. In a free attitude discussion, the researcher encourages the participant to speak freely and openly about their opinions and beliefs without any predetermined questions. The discussion is typically unstructured, which allows the participant to share their thoughts in more detail, and the researcher can follow up on topics as they arise.

This approach to data collection is particularly helpful in understanding complex issues and contexts where there may be a need for participants to express themselves beyond the constraints of a structured interview. It can also be useful for exploring attitudes and beliefs that may be sensitive or difficult to express in a more structured format. One of the strengths of free attitude discussion is that it provides a rich understanding of the participant's views in their own words, rather than being influenced by the researcher's preconceived ideas or presuppositions. It also allows the researcher to learn about the participants' non-verbal behaviours, such as tone of voice, facial expressions and body language, which can contribute to a more comprehensive understanding of the topic.

The researcher did not have structured questions for the discussions; however, the following questions were adopted for the discussions in the data collection process:

1. What are the PST EMS perceptions of the use of Jigsaw in the classroom as a teaching strategy?
2. How effective is the Jigsaw puzzle strategy in teaching ECs?
3. How can PST incorporate Jigsaw puzzles into their future lesson plans?
4. What are the recommendations that can be made to ensure the use of Jigsaw benefits the PSTs in the future economics classroom?

Before the actual free attitude discussions, the participants started the session by playing a Jigsaw puzzle game to complete and answer ECs 'the multiplier', the researcher also observed. Originally, Jigsaw puzzles were made using maps pasted on wood and cut into small pieces by European map makers in the 1760s (Hannas 1972). It was intended to teach students how to assemble maps about their countries and cultures. Different answers about the multiplier effect calculations were cast in different puzzles and participants had to discuss among themselves, which relevant puzzle could be used as the correct answer.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Central University of Technology Faculty Research and Innovation Committee (No. HREIC SF 06/02/2023).

Research ethics involves principles guiding researchers to conduct their research with integrity, respect and fairness towards all parties involved in the research process. Writing a research paper involves ethical considerations that can influence the quality and integrity of the research. One critical

ethical consideration that a researcher should consider when writing a research paper is obtaining ethical clearance.

Receiving ethical clearance is essential because it ensures that the researcher adheres to ethical principles in all aspects of the research process. Moreover, ethical clearance protects the welfare of the participants, ensures that the data is collected legally and maintains the confidentiality and privacy of the participants. The research received ethical clearance from Faculty Research and Innovation Committee.

Data analysis

The study preferred critical discourse analysis (CDA) as a tool to interpret data collected. Critical discourse analysis is an approach to analysing language and communication that goes beyond the surface-level interpretation of texts (Anderson & Holloway 2020). It aims to uncover the underlying power dynamics, ideologies and social structures that shape the way language is used and the impact it has on individuals and society.

In relation to the study of using Jigsaw puzzle games as a CS to augment PSTs' understanding of calculations in the economics classroom. Critical Discourse analysis was a valuable tool as it allowed the researcher to dig beneath the surface of PST EMS were discussing about the Jigsaw strategy and the researcher uncovered deeper social, ideological, and power-related factors that shape their understanding and experiences in the economics classroom as discussed in this findings.

Results and discussion

In spite of the fact that participants spent some time trying to find the correct solution to the puzzle, they found the game extremely insightful and interesting. They took some time to respond because responses to economics questions may be identical or ambiguous to the extent of confusing the respondent. For example, looking at the following multiple-choice question (see Figure 1).

Upon reflecting on the Jigsaw as a game, they alluded to its playful, fun and insightful nature as well as its ability to ignite critical and deep thinking to arrive at the right solution. The participants found the game to be a great way to practice problem-solving skills. They discussed the importance of being able to think creatively, logically and collaborate with others to find the right solution. It was inspiring to see how they worked together and supported each other to reach a successful outcome. It seems to have been a transformative experience for some of the PST EMS. The Jigsaw game was also seen as a great way to help build team spirit and foster communication and collaboration between team members.one of the participants added.

> 'I was not comfortable at first as I prefer working alone which requires more time and the game taught me, I can be creative and get a lot done when I work with other, I has change my view about team work.' (Participant 5, female, third year)

Findings through CDA of the free attitude discussions indicated that the use of the Jigsaw strategy in the classroom has been perceived positively by pre-service EMS teachers as it promotes cooperation and active participation among the participants. Jainal and Shahrill (2021) discuss that Jigsaw process encourages listening, engagement and critical thinking. It also allows participants to specialise in one aspect of a topic and become more involved in promoting each other's learning (Jainal & Shahrill 2021). Furthermore, the Jigsaw technique is perceived as an efficient way to learn calculations in a cooperative learning style. It breaks classes into groups that are dependent on each other to succeed, which encourages interdependent learning among learners. This view was upheld by one of the participants, who said:

> 'I was not aware that working together with others can make the calculations interesting and, fun. It required a lot of teamwork to get through.' (Participant 5, female, third year)

The adoption of the Jigsaw technique within the classroom environment offers notable benefits, encompassing the enhancement of learning outcomes and the bolstering of learner motivation (Jainal & Shahrill 2021). By examining these findings through the lens of architecture theory, the study discerns that the Jigsaw technique, akin to the design and construction of a robust architectural structure, not only facilitates a profound depth of understanding but also actively engages PST EMS in the dynamic construction of their own knowledge, shifting away from the conventional passive presentation of material. Consequently, it highlights the architectural synergy of PST EMS collaborating to co-create a solid foundation of knowledge. Thus, the Jigsaw technique emerges as an architectural blueprint for fostering comprehensive knowledge, coordinating PST EMS to actively immerse themselves in the edifice of content. In this study, Jigsaw constructs a supportive scaffold for PST EMS, nurturing their confidence and underscoring the architectural principles of cooperative learning. Much like a captivating architectural marvel, PST EMS derives enjoyment from the Jigsaw strategy, finding it not only intriguing but also instrumental in nurturing their active participation in the construction of their educational edifice.

'Relationships between economic variables can be expressed in the form of (Cingano 2014):

○ a. a graph.
○ b. an equation.
◉ c. a table.

(Looking at different topics of economics the above responses may all be correct. The graph can show the relationship between price and demand variables "ceteris paribus", while the coefficient can be a numerical equation showing correlation coefficient formula etc.)'

Source: Cingano, F., 2014, 'Trends in Income Inequality and its Impact on Economic Growth', *OECD Social, Employment and Migration Working Papers*, No. 163:28-29, OECD Publishing, Paris.

FIGURE 1: Multiple choice question.

Lastly, one participant seemed to have a reservation that even though Jigsaw may be a desired CS to achieve simplified calculations in her future economic classroom. It may require numeric skills, willingness, pedagogical knowledge and pedagogical content knowledgeable novice teachers. The participant implied that pedagogical knowledge and pedagogical content knowledge are necessary for novice teachers to effectively use the Jigsaw technique. This hidden assumption implied that the Jigsaw technique requires a certain level of expertise and competence beyond merely understanding the subject matter. Furthermore, the statement indirectly highlights the significance of secondary school educational backgrounds in shaping individuals' readiness for EE at the tertiary level.

This reservation emanated from a view by another participant who argued:

> 'Some of my counterparts in economics lecture have no mathematical nor economics background from secondary school and don't like calculations.' (Participant 3, male, third year)

The participant highlights that some of their colleagues in economics lectures have no prior mathematical or economics background from secondary school. This discursive practice draws attention to the perceived inadequacies in their peers' foundational knowledge. It positions a lack of prior mathematical or EE as a notable factor in the participants' reservations about implementing the Jigsaw technique. The participant's statement also underscores the reluctance of some counterparts to engage with calculations. This discursive practice portrays calculations as an undesirable aspect of EE, implying that these individuals might resist using the Jigsaw technique because of their aversion to mathematical aspects of the subject.

Recommendations

Based on the findings and the CDA of the study on the use of the Jigsaw strategy as a curriculum approach for pre-service EMS teachers, several recommendations can be made:

Promotion of collaborative learning

The study highlights that the Jigsaw strategy promotes collaboration, teamwork and active participation among PST EMS. Therefore, it is recommended that teacher education curriculum incorporate collaborative learning approaches into their curriculum to prepare future teachers for effective classroom instruction.

Pedagogical knowledge enhancement

As some participants expressed concerns about the need for pedagogical knowledge, it is recommended that teacher education curriculum offer courses or modules focused on pedagogical training. These courses can equip PST EMS with the instructional strategies and teaching methodologies needed for effective economics instructions.

Taking account of different educational backgrounds

The study underlines the diversity in educational backgrounds among PST EMS, with some lacking prior mathematical or EE. Teacher education curriculum should acknowledge this diversity and provide support and resources to bridge knowledge gaps, ensuring that all PST EMS are adequately prepared to teach economics effectively.

Support for avoidance of calculations

Participants' aversion to calculations highlights the need to address this challenge proactively. Teacher education curriculum can offer workshops or resources to help PSTs develop a more positive attitude towards mathematical aspects of economics, making it a more accessible subject.

Awareness and advocacy

Create awareness among educational policymakers, school administrators and teacher educators about the benefits of innovative teaching strategies like the Jigsaw technique. Advocate for the inclusion of such strategies in curriculum planning and teacher education curriculum.

Continuous research

The study recommends continuous research on the impact of the Jigsaw technique and similar collaborative strategies on student learning outcomes in EE. Regularly evaluate the effectiveness of these strategies in real classroom settings to refine and adapt instructional practices.

The findings suggest that the Jigsaw as a curriculum practice strategy holds promise as an effective pedagogical approach for PST EMS. Implementing the above recommendations can help prepare future educators to teach economics more effectively, regardless of their prior educational backgrounds and ultimately benefit the learning experiences of future learners in the subject. The study also encourages further research on the perspectives of PSTs who are performing below average on how Jigsaw technique may be used to augment their ability to understand ECs.

Conclusion

Through Jigsaw, PST EMS can collaborate and share collective knowledge and pedagogical practices to improve their understanding of teaching calculations and concepts in economics. Furthermore, Jigsaw promotes active learning and critical thinking, which are essential skills for PST EMS in creating an effective and engaging learning experience for their future classroom. By using Jigsaw, PST EMS can develop a deeper understanding of the interconnection of different economics concepts and calculations. Additionally, Jigsaw encourages an inclusive classroom environment where all learners can express themselves and participate actively in the learning process. This approach is critical in fostering a positive learning environment that can lead to a

better understanding of calculations and concepts in economics. Therefore, introducing Jigsaw as a CS for PST EMS can significantly improve their ability to teach calculations and concepts in economics effectively. However, the implementation should be accompanied by consistent support and training to ensure that PST EMS – can implement this strategy appropriately in different classroom situations, hence facilitating an effective learning process for their future economic classroom.

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Data availability

The raw data for this study is protected under the *Protection of Personal Information Act* (POPI Act). and is unavailable.

Disclaimer

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